

RADIO SERVICE

IN LOUISVILLE AND KENTUCKY



NATIONAL YOUTH ADMINISTRATION
FOR KENTUCKY

Before Choosing a Vocation

Determine _ _ _ _ _

1. If it is in line with your interests and abilities.
2. If the rewards and benefits you will get from it are worthy of your efforts.
3. If you can afford the time and expense to prepare for it.
4. If it offers opportunities for the future.

Foreword

This monograph aims to present an over-view of the vocation of radio service man. It may suggest to some boys a possible outlet for their mechanical abilities; to others it may prove that an occupation which they had thought of choosing is not suited to their skills. There is no intention either to encourage or to discourage individuals to accept or to reject the vocation.

We wish to acknowledge the assistance given in the preparation of this monograph by Messrs. P. I. Burks and A. R. Burks, experts in radio, of Louisville, Kentucky; Mr. John B. Kramer, instructor of Radio, Louisville Institute of Technology; and Mr. Rufus E. Smith, in charge of general office maintenance, Louisville office of Postal Telegraph. These experts in radio made valuable suggestions and criticised the manuscript.

We are grateful to the publishers of "Radio Today" for statistical material.

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To the Counselor:

Probably no field offers wider opportunity to the boy who is mechanically inclined and who wishes to enter upon a vocation which is limitless in its possibilities, than does radio. The growth of the industry has been phenomenal. Whereas, in 1920, only a few hundred amateurs owned receiving sets, most of which were operated by manipulating a "cat-whisker" over a crystal, there are now in the United States over 23,000,000 sets in homes. Three million automobiles are equipped with radios.

While this phase of radio reception, planned for advertising, entertainment and education, has shown tremendous gains, it is still in its infancy. Each year brings new refinements in receivers and new developments in broadcasting technique.

Application of the principles of radio has made possible greater safety on land and sea, and in the air. Public safety is increased through the use of radio by police departments, for many cities maintain stations from which they may broadcast information to squad cars equipped with receiving sets.

Closely allied industries offer employment to the radio service man. With the constant growth in the electrical field, the well-trained youth who has radio as his vocation and who keeps abreast of the times need never fear unemployment. Approximately 125,000 people are engaged in servicing and installing receiving sets in this country. In Kentucky there are about 2,500 engaged in this work. It is estimated that all phases of radio provide full-time employment for 300,000 American workers.

This monograph is intended to point out particularly the demands and possibilities of radio servicing as a vocation.

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INTRODUCTION

The development of radio has been both rapid and extensive. Radio forty-five years ago was barely an idea. Today there are approximately 26,000,000 receiving sets in use in the United States. Over 625 licensed broadcasting stations, using over 1,500,000 watts of power, are in operation. Events of nation-wide interest are broadcast over 60-station hook-ups. Receiving equipment having a market value of \$500,000,000 is being sold annually. Seventy per cent of the nation's families have radios.

Guglielmo Marconi, an Italian inventor and electrical engineer, generally is credited with the invention of radio. As early as 1890, Marconi undertook experiments to demonstrate his theory that electrical current passes through any substance, and when started in a given direction, follows a direct course without the assistance of any sort of conductor. In 1896, the Italian inventor sent his first wireless message a distance of one and three-fourths miles. A few years later, in 1901, he sent the first transatlantic message, which was transmitted from Cornwall, England, and received in Newfoundland. Marconi came to the United States in 1899 and continued his experiments in this country. Through his radio system he reported the presidential election of 1900.

The World War brought about important developments in radio. Previous to the war, radio was used mainly by ships in communicating with each other, or with shore stations. At the beginning of the war practically all of the world's cable lines converged in London. This cen-

tralization of cable communication greatly handicapped many nations and stimulated engineering research in the field of radio. Today the United States is linked by direct radio communication with more than sixty nations.

Dr. E.F.W. Alexanderson and Dr. Lee D. Forrest, both Americans, made important contributions to radio development during the war era. Dr. Alexanderson developed the high frequency alternator which first made possible long distance communication by radio on a positive and commercial basis. The vacuum tube was invented by Dr. Forrest.

In addition to providing entertaining programs at all hours, radio is of unlimited value in the United States as a medium of advertising. Commercial advertisers defray the cost of broadcasting operations and make possible free entertainment. In some foreign nations, radio stations are owned, operated, and controlled by governments, and the owners of receiving sets are required to pay relatively high license fees in order to meet the cost of producing and broadcasting radio programs.

Progress continues in radio engineering as important improvements are being made each year. Two-way radio communication has lessened the hazards of air and water travel. Radio direction finders guide planes in the air and vessels at sea. Radio has awakened public interest in such successful scientific ventures as Byrd's expedition to Little America and the stratosphere ascent.

Among the most recent applications of radio to commercial enterprise is high speed facsimile communication. Written, printed and photographic material is now sent by radio and reproduced with exactness at the receiving end. Television is technically an accomplished

fact. The recent discovery of the ultra-high frequency radio channels would lead to the belief that the first fifteen years of commercial radio have merely scratched the surface.

In order that chaotic air conditions might be remedied, the Federal Radio Commission was created in 1927. This body now regulates broadcasting and assigns station frequencies.

RADIO INVENTED by KENTUCKIAN

Nathan Kane in his book, "Famous First Facts," names Nathan B. Stubblefield, of Murray, Kentucky, as the first person to demonstrate radio broadcasting. In 1892, he sent through the air a message to Rainey T. Wells, a young lawyer and friend, the words "Hello, Rainey." This message, Mr. Kane contends, was the first sent by air without aid of wires.

Stubblefield's only equipment for his first broadcast included a mysterious box, some telephone apparatus, and two coils of wire. This Kentuckian had performed one of the greatest scientific "miracles" in history in the little town of Murray, Kentucky.

Reports of Stubblefield's feat spread throughout the nation, and eastern capitalists and scientists came to him on his farm at Murray with various offers. Stubblefield reputedly refused \$500,000 for his invention. His realization of the value of his work lead him to hold out for more money. Because of his failure to capitalize at this time, he received neither honor nor remuneration for his invention. In 1902, the Kentucky inventor gave public exhibitions of his broadcasting apparatus at Fair Mount Park, Philadelphia, and in Washington, D. C. His voice was broadcast one mile away. A patent was granted Stubblefield in 1908, but at this time it was almost valueless because others also were progressing in the same field.

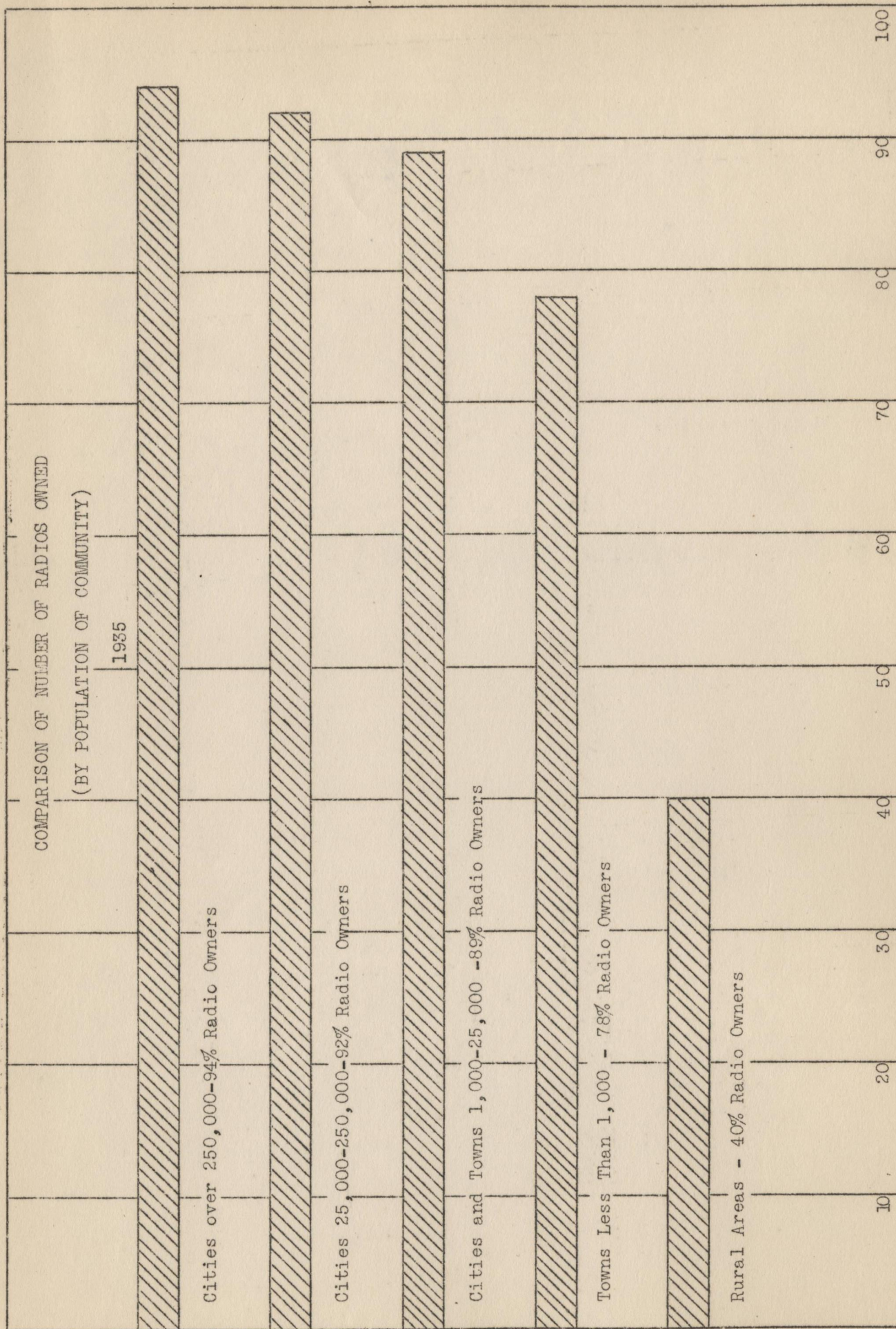
The first marine radio demonstration of wireless broadcasting was given on the steamer "Bartoldi" on the Potomac River in 1902. The apparatus used in this broadcast was the invention of Stubblefield.

The Murray inventor died March 30, 1928. His body was found in the little hovel near Murray in which he had lived as an eccentric hermit, since his return from the disappointing stay in the East. As Mr. Kane states in his book, the discoverer of the fundamental principles of modern radio broadcasting, a penniless pauper, had actually starved to death.

IMPORTANT "FIRST FACTS" OF RADIO

THE FIRST RADIO EVENTS GIVING YEARS IN WHICH THEY OCCURRED:

- 1892--First radio message sent at Murray, Ky., by Nathan B. Stubblefield to Rainey T. Wells.
- 1892--First radio broadcast Murray, Kentucky, by Nathan B. Stubblefield.
- 1896--First radio message sent by Marconi.
- 1902--First demonstration in Philadelphia and Washington, D. C.
- 1901--First transatlantic message, Cornwall, England, to New Foundland, by Marconi.
- 1903--First United States radio station established.
- 1907--First radio message of the regular westward service.
- 1908--First radio patent granted to Nathan B. Stubblefield, Murray, Ky.
- 1909--First radio telephone message sent across the Atlantic.
- 1909--First radio S.O.S. and C.Q.D. signals.
- 1911--First radio license granted to George Hill Lewis, of Cincinnati, Ohio.
- 1915--First radio-telephone message sent across Pacific.
- 1920--K.D.K.A., Pittsburg, Pa., the first permanent radio broadcasting station, established.
- 1920--First radio broadcast of a Presidential campaign (Harding-Cox)
- 1921--First radio broadcast of a religious service (Calvary Episcopal Church, Philadelphia, Pa., Station K.D.K.A.)
- 1923--First radio broadcast of a presidential message.
- 1924--First radio television across the Ocean-London to New York.
- 1927--First radio commission of five men: Henry A. Bellow, Admiral W.H.G. Bullard, Orest H. Caldwell, John F. Dillon, Eugene O. Sykes.
- 1927--First radio television apparatus to operate over any considerable distance.
- 1928--First placed under the jurisdiction of the Department of Commerce.
- 1929--First airplane picture show.
- 1930--First radio program broadcast from a ship at sea.
- 1930--First television talking pictures at Schenectady, N. Y.
- 1930--First two-way demonstration of television.



STATES, POPULATION, RADIO HOMES, AND RADIO DENSITY FOR THE
UNITED STATES AND TOTAL FOR THE UNITED STATES

	STATE	POPULATION	RADIO HOMES	RADIO DENSITY
1.	NEW YORK	12,588,066	2,993,100	238
2.	PENNSYLVANIA	9,631,350	1,938,400	201
3.	ILLINOIS	7,630,654	1,674,300	220
4.	CALIFORNIA	5,677,251	1,398,900	246
5.	OHIO	6,646,697	1,396,900	210
6.	MASSACHUSETTS	4,249,614	946,900	224
7.	MICHIGAN	4,842,325	936,600	193
8.	NEW JERSEY	4,041,334	897,500	222
9.	TEXAS	5,824,715	862,100	148
10.	MISSOURI	3,629,367	708,500	195
11.	INDIANA	3,238,503	616,800	191
12.	WISCONSIN	2,939,006	576,600	196
13.	MINNESOTA	2,563,953	535,600	209
14.	IOWA	2,470,939	503,100	204
15.	CONNECTICUT	1,606,903	373,200	232
16.	KANSAS	1,880,999	348,000	185
17.	WASHINGTON	1,563,396	346,900	222
18.	NORTH CAROLINA	3,170,276	341,800	108
19.	VIRGINIA	2,421,851	336,900	138
20.	OKLAHOMA	2,396,040	335,000	140
21.	GEORGIA	2,908,506	334,500	115
22.	TENNESSEE	2,616,556	328,900	126
23.	MARYLAND	1,631,526	320,000	196
24.	KENTUCKY	2,614,589	313,800	120

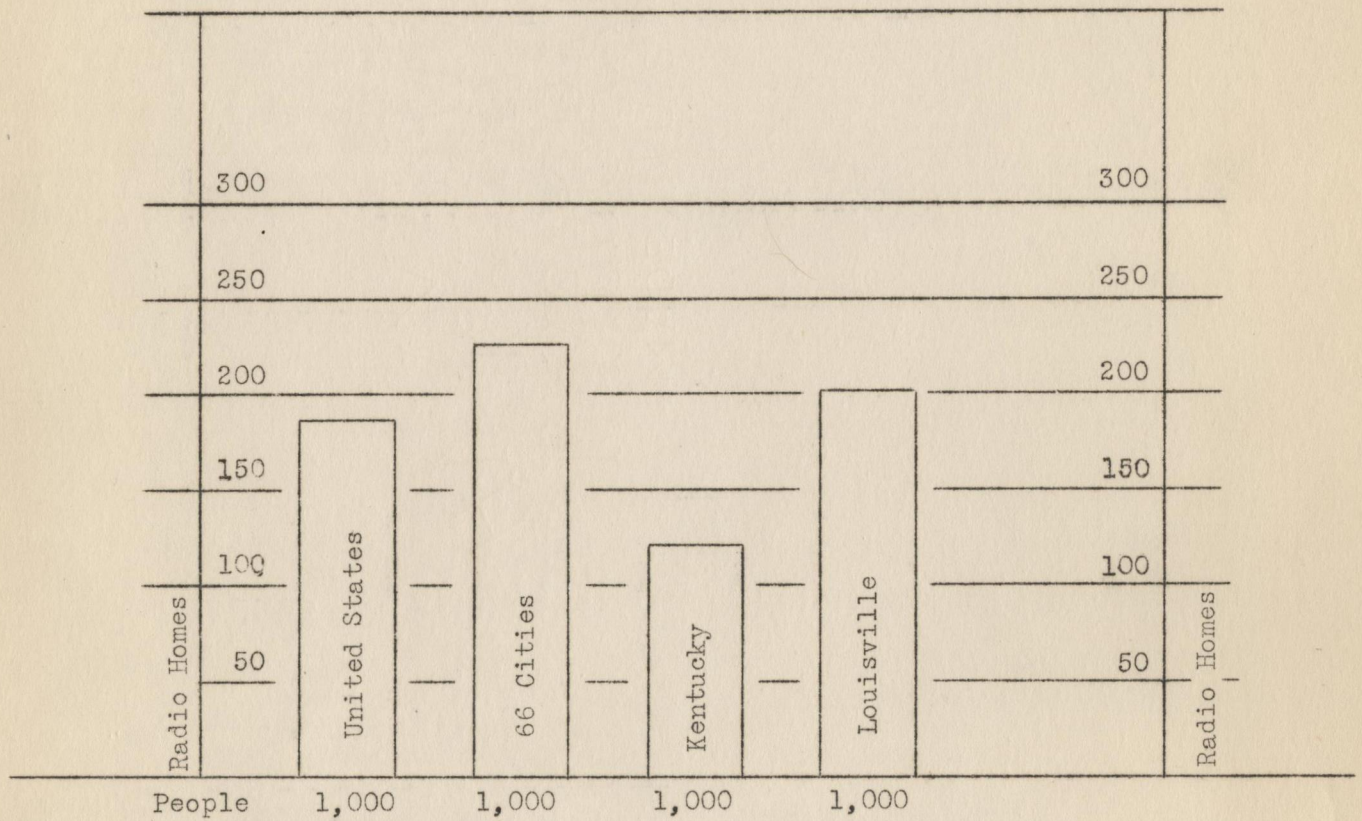
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	STATE	POPULATION	RADIO HOMES	RADIO DENSITY
25.	NEBRASKA	1,377,963	266,800	193
26.	ALABAMA	2,646,248	258,000	97
27.	LOUISIANA	2,101,593	260,000	124
28.	W. VIRGINIA	1,729,205	240,000	139
29.	FLORIDA	1,468,211	233,900	160
30.	OREGON	953,786	216,400	227
31.	COLORADO	1,035,791	206,600	199
32.	ARKANSAS	1,854,482	187,300	101
33.	S. CAROLINA	1,738,763	174,600	101
34.	MISSISSIPPI	2,009,821	166,400	83
35.	MAINE	797,423	163,600	205
36.	RHODE ISLAND	687,497	150,000	218
37.	DIST. OF COLUMBIA	486,869	125,000	256
38.	S. DAKOTA	692,849	107,000	155
39.	N. DAKOTA	680,845	100,500	147
40.	NEW HAMPSHIRE	465,293	99,700	214
41.	MONTANA	537,606	91,700	171
42.	UTAH	507,847	85,000	168
43.	IDAHO	445,032	75,800	170
44.	VERMONT	359,611	72,400	202
45.	ARIZONA	435,573	62,500	144
46.	NEW MEXICO	423,317	48,300	114
47.	DELAWARE	238,380	47,100	199
48.	WYOMING	225,565	44,600	197
49.	NEVADA	91,058	21,700	238
	TOTAL UNITED STATES	122,775,046	22,869,000	186

*Figures from RADIO TODAY--July 1936

"RADIO DENSITY" SHOWS THE NUMBER OF RADIO HOMES

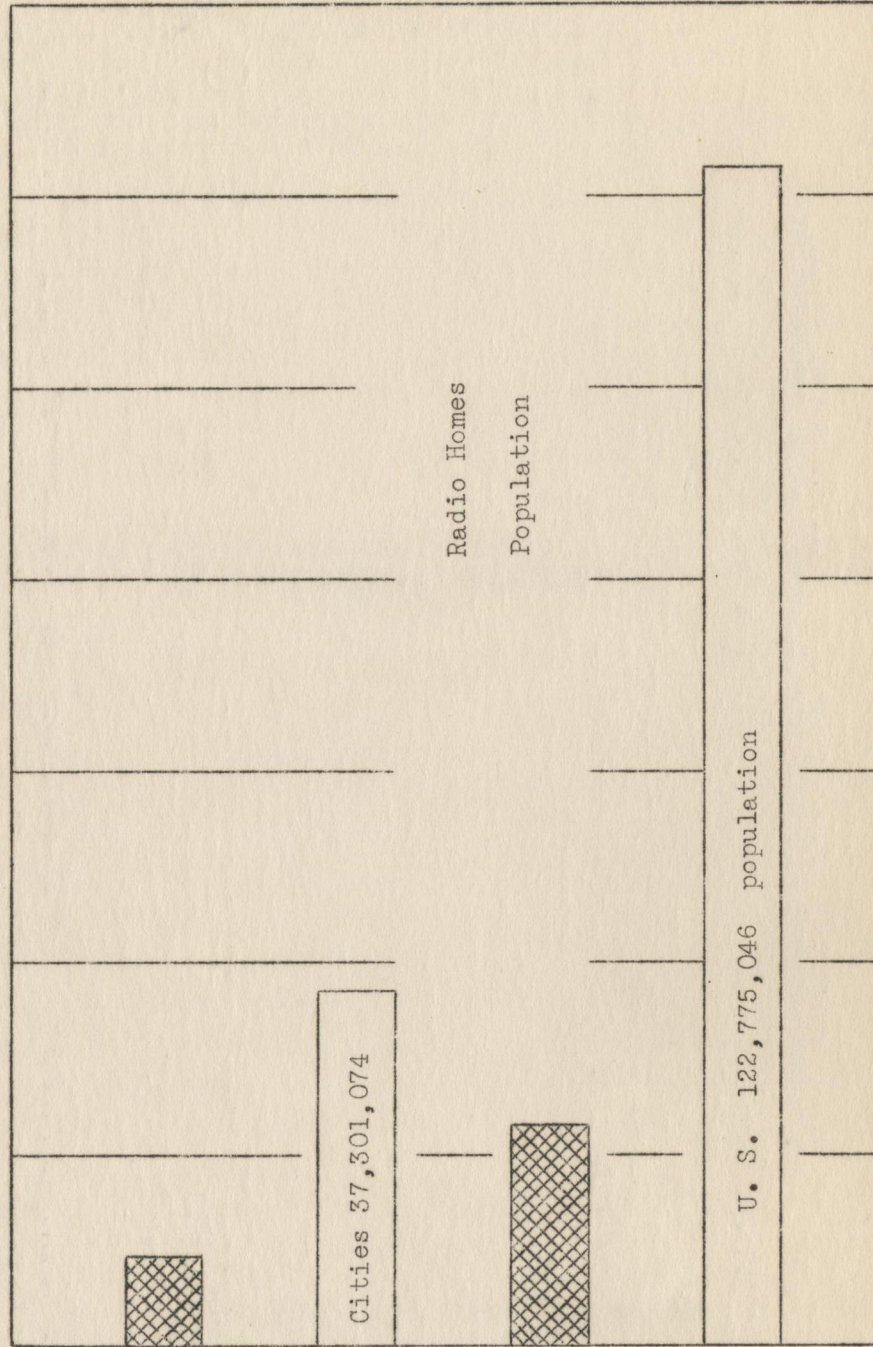
PER 1000 PEOPLE



Figures from "Radio Today"
July 1936

POPULATION AND RADIO HOMES FOR THE UNITED STATES

AND 66 KEY CITIES



Figures from "Radio To-day" - July 1936
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KEY CITIES BY STATE, POPULATION, RADIO HOMES AND RADIO DENSITY

CITY	STATE	POPULATION	RADIO-HOMES	RADIO DENSITY
NEW YORK CITY	NEW YORK	6, 930,446	1, 663,000	241
CHICAGO	ILLINOIS	3,982,123	908,300	228
LOS ANGELES	CALIFORNIA	2,208,492	592,800	268
PHILADELPHIA	PENNSYLVANIA	1,950,961	430,300	220
DETROIT	MICHIGAN	1,888,946	398,300	211
PITTSBURG	PENNSYLVANIA	1,374,410	301,600	219
CLEVELAND	OHIO	1,201,455	272,200	226
ST. LOUIS	MISSOURI	1,033,553	240,200	233
BALTIMORE	MARYLAND	929,439	211,300	227
NEWARK	NEW JERSEY	833,513	200,300	241
BOSTON	MASSACHUSETTS	879,536	190,900	217
SAN FRANCISCO	CALIFORNIA	634,394	170,000	269
MILWAUKEE	WISCONSIN	725,263	167,800	232
CINCINNATI	OHIO	589,356	141,100	240
MINNEAPOLIS	MINNESOTA	517,785	122,300	236
KANSAS CITY	MISSOURI	470,454	121,000	258
PROVIDENCE	RHODE ISLAND	540,016	120,700	224
SEATTLE	WASHINGTON	463,517	120,200	260
NEW HAVEN	CONNECTICUT	463,449	106,100	229
INDIANAPOLIS	INDIANA	422,666	102,900	243
HARTFORD	CONNECTICUT	421,097	98,500	234
PORTLAND	OREGON	338,241	91,400	270
NEW ORLEANS	LOUISIANA	453,762	90,800	198

Continued-

CITY	STATE	POPULATION	RADIO-HOMES	RADIO DENSITY
HOUSTON	TEXAS	359,328	88,300	245
DALLAS	TEXAS	325,691	80,400	247
ATLANTA	GEORGIA	338,865	77,700	200
DENVER	COLORADO	287,861	73,800	257
LOUISVILLE	KENTUCKY	355,350	71,700	202
ST. PAUL	MINNESOTA	286,721	65,200	228
BIRMINGHAM	ALABAMA	431,493	62,100	144
MEMPHIS	TENNESSEE	306,482	61,400	200
OMAHA	NEBRASKA	232,982	53,700	230
GRAND RAPIDS	MICHIGAN	240,511	51,800	215
OKLA. CITY	OKLAHOMA	221,738	50,100	227
NASHVILLE	TENNESSEE	222,854	47,300	212
RICHMOND	VIRGINIA	213,239	47,100	221
NORFOLK	VIRGINIA	213,353	44,800	210
DES MOINES	IOWA	172,837	44,400	257
TULSA	OKLAHOMA	187,574	43,400	232
SALT LAKE CITY	UTAH	194,102	41,600	214
SPOKANE	WASHINGTON	150,477	38,000	246
MIAMI	FLORIDA	142,955	35,800	250
WILMINGTON	DELAWARE	161,032	35,000	217
WICHITA	KANSAS	136,330	34,600	254
MANCHESTER	NEW HAMPSHIRE	140,165	30,900	220
JACKSONVILLE	FLORIDA	155,503	30,800	198

Continued-

CITY	STATE	POPULATION	RADIO-HOMES	RADIO DENSITY
PORTLAND	MAINE	134,645	30,300	225
PHOENIX	ARIZONA	150,970	25,500	169
LITTLE ROCK	ARKANSAS	137,727	24,900	181
CHARLOTTE	N. CAROLINA	127,971	24,600	192
LINCOLN	NEBRASKA	100,324	22,300	223
KANSAS CITY	KANSAS	141,211	21,900	155
WHEELING	W. VIRGINIA	72,077	16,900	235
HUNTINGTON	W. VIRGINIA	90,786	16,400	181
CHARLESTON	S. CAROLINA	101,050	15,600	155
WINSTON-SALEM	N. CAROLINA	111,681	15,200	137
JACKSON	MISSISSIPPI	85,118	13,000	153
BUTTE	MONTANA	56,969	11,500	202
SIOUX FALLS	S. DAKOTA	50,872	11,300	223
BURLINGTON	VERMONT	47,471	10,600	223
ALBUQUERQUE	N. MEXICO	45,430	9,100	200
BOISE	IDAHO	37,925	8,900	235
FARGO	N. DAKOTA	48,735	8,900	183
RENO	NEVADA	27,158	6,900	254
CASPER	WYOMING	24,272	6,400	264
CHEYENNE	WYOMING	26,845	6,200	231
TOTAL 66		37,301,074	8,429,021	225

*Arranged from RADIO TODAY
July, 1936

RADIO SERVICE AS A VOCATION

Radio servicing involves installation of new sets, location and correction of radio troubles, and making repairs. Related duties are selling, informing radio owners of various features, offering instruction as to radio care, and giving information regarding the latest improvements in all phases of radio.

Closely allied to radio service work is electric refrigeration service. Many establishments sell both radios and refrigerators; consequently, their service men are also required to know principles, parts, and workings of electric refrigerators. Mechanical skill in both of these fields is a decided advantage.

In order to give best performance a radio, first of all, should be properly installed. Installation itself involves several features. First the aerial should be of the right type, correctly installed, and well located. It is essential that ground connections be made carefully. The ground hook-up must be properly completed. The importance of installation places the service man in a key position, in which he assumes a large portion of the responsibility for making the mechanism satisfactory to the purchaser. The good will and success of the entire industry are affected by his efficiency.

Like other mechanical contrivances, the radio does not remain in good working condition indefinitely. Parts wear out and connections may become loose. Owing to this fact, the radio service man is kept busy locating and correcting troubles. In order to perform his work effectively, he is required to know the principles of electricity and the

functions performed by each bit of radio mechanism. He must have a particular knowledge of those parts of the machine that are most likely to cause trouble.

Generally, the radio service worker performs his tasks in the home of the radio owner.

An expert knowledge of both old and new testing devices, and of the variation between old and new parts, also is of great importance, as the location of trouble often is a greater problem than the actual repair work. The re-conditioning of a radio requires the worker to dismantle and re-assemble the apparatus.

In the related field of selling, the radio service worker's knowledge of the various features of the radio gives him an advantage over the salesman who does not possess technical knowledge. Usually, however, this work is only incidental to his major functions of servicing machines and installing new sets.

We see then that the radio service man must be a mixture of scientist and mechanic, of salesman and business man. Certainly he must know the fundamental principles of electricity and magnetism. Unless he understands cause and effect he cannot hope to be successful. He must have an inquiring mind and a willingness to devote hours of study to new ideas in his chosen field. He must have the skill to manipulate delicate materials and instruments, and the ability to follow intricate directions.

As has been mentioned, ability to sell is necessary in many servicing jobs. If the service man is employed by a retail store, he may increase his earnings substantially by commission on sales. If he is a

successful salesman, he may become the owner of his own business. This will require that he become familiar with advertising, keeping accounts, and the many details accompanying the successful operation of a small business. His store will probably stock radio accessories and other electrical appliances.

(A new light-testing device is described in "Radio News" for September 19, 1936. This article suggests the radio service man may add to his income by carrying a side line of lamps and lamp accessories. This tiny device may be carried in his kit. The sales-service man will find no difficulty in showing many customers that their lighting facilities are inadequate and a sale will result.)

Another possibility for going into business for himself, is presented by the wide demand for installation and operation of sound systems. Radio servicing may open the door to a wide range of vocational interests.

As has been pointed out, there is a demand for the trained service worker. During the years of widespread unemployment, people from other occupations who had some knowledge of radio, attempted to earn some money by repairing receiving sets. Now most of them have returned to their former vocation, leaving the field to the 100% service man.

Recently a new word has been coined to describe the radio service man who can meet the tests of the Institute of Radio Service Men. That word is "Radioneer," a contraction of radio engineer. Men permitted to use this title must have passed the examination of the National Board of Radio Service Standards, and must agree to abide by the trade practices laid down by the Radio Service Registry to insure fair dealings

between the service man and the public.

Another effort to professionalize the business is seen in plans to have state legislatures pass an act requiring radio servicemen to be licensed. This project is being sponsored by the Radio Technician's Guild.

THE FUTURE OF THE VOCATION

The vocation of radio operator and allied industries is not overcrowded. Expansion is going on in all these industries creating additional demands for the operator. The action of the International Convention for the Safety of Life at Sea has increased the need for operators. Every ship must be equipped with radio and those that previously had carried but one operator are now required to carry two or more.

Aviation is an expanding industry. It is demanding additional operators. So, likewise, is the Department of Communications.

Opportunities for advancement are many and various. An operator serving on a ship may be advanced to shore station operator, chief operator, station engineer, inspector, division manager, or superintendent. He may advance to executive positions in commercial companies, or he may become a radio-phone broadcasting engineer or technician.

Through Civil Service Examination there is open to him the position of junior or assistant radio operator for airways. In the United States Weather Bureau Service there also are positions.

A few opportunities may be found in Geographical Exploration Work.

Amateur operators are in line for these jobs. With training sufficient to get a license, they may enter a vocation that pays well and affords pleasant employment.

In general, it may be said that the vocation has a bright future.

ADVENT OF TELEVISION WILL WIDEN SERVICE NEEDS

Television is an accomplished fact, and already television broadcasts are being given in Europe. Commercial use of this phase of radio has been delayed in the United States because of necessary patent adjustments between the two companies controlling the inventions. When television is added to radio receiving sets the field of the service man will be materially increased.

It is predicted that many homes will be using the new type of receiver in the near future. The retail price of the set will probably be between \$200 and \$300. The images will be reproduced on a space approximate 8" by 10". Field tests are scheduled to begin late in 1936. While some authorities say that this prediction is too optimistic, there is no doubt that television is almost marketable.

There are two systems. One was developed by Dr. Vladimir Zworykin whose first patent papers were filed in 1925. In 1932 he patented the iconoscope.

The other system was developed by Philo Farnsworth, a Utah farm boy. Although he is only thirty years old now, he has spent eleven years in intensive work on television. Already his system has been adopted by the British Broadcasting Company and the Berlin Broadcasting Company. Much of his study has been done in California, but his laboratory is now located in Philadelphia. His other radio inventions are a fog-penetrating beam for ship and airplane pilots, and a process for sterilizing milk by passing radio waves through it.

The following figures indicate the scope of the vocation in Kentucky at the present time:

TUBE RENEWAL MARKET POTENTIALS

STATE OF KENTUCKY - 1936

Number of Families	617,900
Radios in Homes - January 1, 1936	322,000
% of U. S. Total	1.40%
Sets Over 4 Years Old	180,320
Tubes in Sets Over 4 Years Old	1,081,920
Tubes Requiring Replacement	681,610
Retail Dollar Volume:	
Tubes	\$560,000.
Parts	\$210,000.
Wholesale Value New Sets	\$3,324,300.

This replacement business may be broken down by counties on the following percentage basis:

<u>Counties</u>	<u>%</u>	<u>Counties</u>	<u>%</u>	<u>Counties</u>	<u>%</u>	<u>Counties</u>	<u>%</u>
Adair	.31	Edmonson	.22	Knox	.66	Nicholas	.25
Allen	.36	Elliott	.11	Larue	.22	Ohio	.70
Anderson	.24	Estill	.48	Laurel	.45	Oldham	.25
Ballard	.28	Fayette	3.93	Lawrence	.32	Owen	.27
Barren	.70	Fleming	.36	Lee	.22	Owsley	.11
Bath	.27	Floyd	1.15	Leslie	.15	Pendleton	.30
Bell	1.35	Franklin	.76	Letcher	1.18	Perry	1.31
Boone	.31	Fulton	.55	Lewis	.33	Pike	1.69
Bourbon	.73	Gallatin	.13	Lincoln	.44	Powell	.12
Boyd	2.06	Garrard	.28	Livingston	.22	Pulaski	.91
Boyle	.68	Grant	.29	Logan	.63	Robertson	.08
Bracken	.28	Graves	.97	Lyon	.19	Rockcastle	.32
Breathitt	.36	Grayson	.38	McCracken	2.30	Rowan	.25
Breckinridge	.45	Green	.24	McCreary	.39	Russell	.21
Bullitt	.25	Greenup	.65	McLean	.32	Scott	.54
Butler	.26	Hancock	.16	Madison	.85	Shelby	.57
Caldwell	.50	Hardin	.61	Magoffin	.27	Simpson	.34
Calloway	.48	Harlan	2.29	Marion	.43	Spencer	.15
Campbell	4.10	Harrison	.53	Marshall	.30	Taylor	.30
Carlisle	.21	Hart	.36	Martin	.16	Todd	.36
Carter	.56	Henderson	1.05	Mason	.78	Trigg	.27
Carroll	.27	Henry	.38	Meade	.19	Trimble	.12
Casey	.28	Hickman	.22	Menifee	.08	Union	.60
Christian	1.21	Hopkins	1.53	Mercer	.49	Warren	1.25
Clark	.76	Jackson	.17	Metcalfe	.18	Washington	.27
Clay	.29	Jefferson	26.48	Monroe	.25	Wayne	.31
Clinton	.17	Jessamine	.45	Montgomery	.45	Webster	.82
Crittenden	.33	Kenton	5.83	Morgan	.26	Whitley	.94
Cumberland	.18	Johnson	.55	Muhlenberg	1.31	Wolfe	.14
Daviess	1.82	Knott	.26	Nelson	.42	Woodford	.36

-----Supplied through courtesy of Mr. P. I. Burks

QUALIFICATIONS of THE RADIO SERVICE MAN

No definite educational standards for radio service workers have been established, and men on all levels of academic training are found in this field. Academic education, obviously, is advantageous and generally the most successful service workers are those who have received high school or college training. The academic subjects most valuable to the service worker are mathematics, physics, and English. The fact that the radio service man is called into the homes of the most cultured people and talks with educated people, enhances the value of academic education, and of his ability to speak good English, in particular. Academic education is of greater importance to applicants for government work in radio service, as written competitive examinations are given.

Technical training, which may be secured either in school or in the radio shop, or in both, is necessary. This training should include study of the fundamentals of electricity and of radio construction.

Certain personal characteristics are necessary for success in the field of radio service. Some of the most important qualities are listed below.

(1) Sound judgment.

This involves the ability to discover the external and internal causes of trouble. Satisfactory service can not be rendered through mere guesses at causes of imperfect reception.

(2) Courtesy and tact

These make for pleasant relations with customer and employer. Courteous and tactful workers usually find the road to advancement.

(3) Neatness

Although the clothes and hands are likely to become soiled due to the nature of the service man's work, this fact should not prevent neatness in other respects. Neatness increases the employer's and the customer's valuation of the service man.

(4) Ambition

Unless the desire to excel is present there is little chance for advancement. The ambitious service worker who desires to improve himself and is willing to spend time and effort, not only in his work but also in reading and studying radio and its ramifications, is likely to achieve success.

One should examine himself in the light of the following qualities in addition to those mentioned in detail:

1. Good common sense.
2. Ability to carry out instructions and orders without bungling.
3. Native mechanical skill and interest in mechanics and electricity.
4. Friendliness.
5. Industry.
6. Good Health

THE RADIO TECHNICIAN

The technician, in general, is a better trained and more proficient workman than the service man. The service man rarely has a government license. His knowledge of transmitters and transmission may be imperfect. His educational training often is limited. The technician is skilled in all branches of the service. He has a more thorough knowledge of radio theory and mathematics than the service man or operator has. He is licensed by the government when in police or general government service. He is a specialist in more than one field, and more highly trained than the service man.

While work of the technician is similar to that of the service man, it is not so limited. He must be able to read diagrams, and must know the use of every bit of apparatus in the set. His knowledge must be complete, for he will be expected to diagnose and correct trouble in the old battery type receiver as well as in the most modern all-wave set. He does repair work, locates and corrects radio trouble in the home, and performs other services of an exacting character. He should be able to drive an automobile for much of his work is of the emergency type, requiring immediate attention.

The educational training of the technician is more specific and exacting than that of the service man. He must have thorough knowledge of general mathematics and of its higher branches. He must know the theory of radio and of electricity. The personal qualifications demanded of the service man are also required of the technician if he is to succeed.

Working Conditions

The technician usually receives a larger salary than the service man. Technicians' salaries range from \$150.00 a month upward. If the technician has selling ability he may often add materially to his income by persuading his customer to trade his old set for a new model.

The working hours of the technician and the service man are practically the same. He must always be prepared for emergencies that may develop.

Advantages

In addition to the same favorable circumstances that surround the service man, the superior educational training and proficiency of the technician open fields of opportunity closed to the average service man. For example, he may work in one line when the season is at its best, and change to another when there is a slump. The range of his activity is limited only by his initiative.

The radio industry is a rapidly growing one. As the industry expands the opportunities of the technician increase. If he is well-trained, he may expect full time employment at a good wage.

THE RADIO OPERATOR

Radio operators may be divided into two groups, amateur operators and commercial operators. The amateur operates his own apparatus, receiving and sending messages. He frequently constructs his own outfit. The commercial operator serves the large stations in receiving and transmitting programs, as well as in commercial communication.

THE AMATEUR

The amateur operator began shortly after Marconi had astounded the world with his wireless telegraphy. He was probably the first amateur; indeed, he so likes to style himself.

Amateur radio's development may be divided into two periods; The first before the World War, and the second, since that war closed. It was in 1914 that Hiram Percy Maxim conceived and formed the American Radio Relay League. The activities of the amateur and the League were stopped by the war.

After the war closed pressure was brought to bear on Congress in order to stop permanent legislation against the amateur radio establishments. After the prohibition of the use of the amateur radio had been removed in October, 1919, many of the older operators renewed their air connections and friendships. New members were added to the League and interest in amateur radio was keener than ever. Today there are thousands of amateurs carrying on and from their ranks come practically all the inventiveness and many of the best radio engineers.

Amateur radio is one of the finest hobbies. It also provides the necessary thinking, training, and experience to fit one for remunerative service with the United States government or with a commercial organization. The army and navy have a thorough appreciation of the amateur as a source of a skilled radio personnel in time of war.

The amateur also has rendered public service of value while working for pleasure. Radio operation is a valuable source of entertainment and paves the way to permanent employment.

The amateur should familiarize himself with the amateur code. The following directions are from "The Radio Amateur Handbook":

1. The amateur is gentlemanly--He never knowingly uses the air for his own amusement in such a way as to lessen the pleasure of others. He abides by the pledge given by the A.R.R.L. in his behalf to the public and government.
2. The amateur is loyal--He owes his radio to the American Radio Relay League and he offers it his unswerving loyalty.
3. The amateur is progressive--He keeps his station abreast of radio science. It is well built and effective. His operating practice is clean and regular.
4. The amateur is friendly--Slow and patient in transmission, when requested, he gives friendly counsel and advice to the beginner. He offers kindly assistance and co-operation to the broadcast listeners.
5. The amateur is balanced--Radio is his hobby. He never allows it to interfere with any of the duties he owes to his family, his job, his school, or his community.
6. The amateur is patriotic--His knowledge and his station are always ready for the service of his country and his community.

THE COMMERCIAL OPERATOR

The commercial operator occupies an important position in modern life. He is the medium through which our radio programs come. Membership in his vocation has grown in numbers and the attractiveness of his work has increased rapidly in recent years. In order that he may practice his vocation he must meet certain requirements. Some of these are discussed below.

Requirements for Commercial Operators

The following are some of the essential requirements of the commercial operator:-

- (1) License - It is necessary that he have a government license.
- (2) Education - The operator's education must at least be the equivalent of grammar school training. The more complete his education, the better will be his chances for success and the wider the range of opportunities before him.
- (3) Technical Commercial Training - The commercial operator's work requires orderliness and dispatch. Training in keeping accounts, use of the typewriter, etc., are of inestimable value to him.
- (4) Technical Training - A number of items are included in this requirement. He must understand radio transmission and reception. He must know about motors, generators, and storage batteries. He must be familiar with radio laws and regulations.
- (5) Civil Service Examination - If one plans to enter government service, it will be necessary for him to pass an examination and secure a rating. Government employees come only from an eligibility list. To be admitted to this examination the operator must meet certain requirements as to age,

education and experience. He must be between eighteen and forty years. He must have acquired the use of good English. The requirement for experience ranges from one to four years.

Working Conditions for Radio Operators

The wages paid operators with the different types of services are:

In the Merchant Marine Service the salary paid licensed radio operators ranges from \$70.00 to \$150.00 per month with living and medical expenses furnished. An indirect compensation comes in the form of the privileges and ranking given the operator. He ranks as an officer and quarters with them.

The operators at the United States Naval Stations get their places through the service. They join the navy for four years and begin at \$21.00 per month and living expenses. The salaries range from this beginning up to the highest paid at naval stations, \$450.00 per month.

At land radio telegraph stations, radio operators are paid from \$150.00 per month upward. They pay their own living expenses. Approximately the same salaries are paid operators in aviation and broadcasting stations.

The Geographical Exploration operators start at a salary around \$150.00 per month. They are allowed living expenses up to \$200.00 per month.

All services using radio operators adhere to the eight hour day as closely as possible. In cases of emergency, the working hours are as long as are required to do the job.

Merchant Marine operators also are on duty eight hours a day. Often when no duties as operators are to be performed, they are expected to do clerical work and sometimes to act as assistants to the Purser during his

eight hour watch. When the ship docks the operators are given shore leave.

Many positions provide vacations with pay.

TOOLS, SUPPLIES AND INSTRUMENTS IN THE SERVICE MAN'S KIT

Pliers, long nosed and diagonal	Drill with assorted bits
Socket wrench set	Files, course and fine
Knife	Sand Paper
Wire nippers	Muslin-Square yard piece
Blow torch and soldering iron	Flash-light
Screwdrivers, heavy and short and long and thin	Hydrometer
Radio set analyzer, speaker unit, headphone, all-wave oscillator, resonance indicator (Out-put meter), and Condenser tester.	

Cathode Ray Oscillograph is a new piece of equipment which costs about \$150.00, but which will be of great value to the 100% service man.

The radio set analyzer, of which there are several on the market, enables the service man to make a thorough analysis of all types of radio receivers. They come in handy carrying cases, having space for all tools and parts needed for minor repairs.

Another instrument which is useful in balancing or neutralizing sets is the modulated oscillator. A simple, but satisfactory, form of the modulated oscillator may be constructed by the service man himself.

The resonance indicator enables the service man to test the fineness of tuning and balancing more accurately than he could do by ear.

Makers of instruments furnish charts on which the service man may enter complete readings from which he may make his ultimate diagnosis. Keeping a file of his charts may save the service worker time on future calls.

In addition, the service man should carry an assortment of mis-

cellaneous supplies, so that his work may be completed as soon as possible, to save his own time and for the customer's convenience.

These facts would indicate that the prospective service worker must be able to supply himself with some equipment, but the cost of the instruments and supplies is not prohibitive. Adequate testing equipment inspires confidence in the customer. As the service worker progresses he will find that the greater the skill, the less equipment required.

WORKING CONDITIONS

Wages and Hours

The average weekly wage throughout the country for radio service workers is \$18.00. The wage for more highly skilled workers ranges from \$25.00 to \$50.00 per week. Besides greater proficiency and skill, other factors, such as attitude toward work and selling ability, affect one's pay. For the smaller communities in Kentucky wages range from \$12.00 to \$20.00 per week. The average weekly wage in Louisville for the radio service man is between \$20.00 and \$35.00.

United States Government service workers receive more. The minimum government salary is \$1800.00 per year, and the salary in the highest range of government employment is \$2800.00 a year.

Occasionally the service man must work over time. In general this service is paid for. However, no uniform rule prevails. It will depend largely upon the employer's rules and agreements with his workers.

No uniform practice prevails as to the hours the service man is on duty, but in general, he works for eight or nine hours a day and for six days a week. In many cases night work, and sometimes work on Sunday, may be required. Such services are in the form of emergency calls, and would not be required regularly.

ADVANTAGES OF RADIO SERVICE WORK

Some of the advantages of radio service work as a vocation may be stated as follows:

(1) A Growing Industry - As a service man, one is a part of a rapidly developing industry where possibilities for expansion have scarcely been touched. Barron M. Mace says in June, 1936, "Radio News", "It may be said with very little fear of contradiction that the opportunities for money-making in the radio industry today are just about double what they were four or five years ago. This may sound very much like an overstatement of the more cynical members of the profession. It is nevertheless an incontrovertible fact that will bear the closest examination."

COMPARISON OF RADIO SET SALES IN 1935 AND 1936

	1935	1936
FIRST QUARTER	1,155,438	1,287,463 (Actual)
SECOND QUARTER	1,074,909	1,600,000 (Actual)
THIRD QUARTER	1,528,684	2,100,000 (Est.)
FOURTH QUARTER	2,267,000	3,100,000 (Est.)
TOTAL	6,026,031	8,087,463 (Est.)

Source: RADIO TODAY-September, 1936

The above table illustrates the increased radio set sales within the last year. Many families are using more than one receiving set in their homes. Auto radio sales have grown remarkably. Portable radios are expected to be a new trade development. Already an eighteen pound golf-bag type of portable radio has been placed on the market. Each radio

set sold makes a potential customer for the service man.

(2) A Demand for Trained Workers - Unlike many vocations, that of radio service man is not overcrowded on the higher levels. There is a demand for the skilled, proficient worker, and the wage he receives is better than the average. It is estimated that one service man is required for each 600 to 800 sets. There are in Louisville approximately eighty full-time service men and about the same number are working in their spare time. In the smaller cities, one service man is found to approximately each five thousand inhabitants.

(3) Promotion - Promotion may be rapid, depending largely on one's ability to fit himself for higher jobs, such as technician, inspector, station engineer, division manager, superintendent, etc. One's advancement is limited only by his desire and capacity.

(4) A Pleasant and Interesting Employment - Some of the factors that contribute to make the service man's work interesting and pleasant are:

Connection with a rapidly developing appliance; association with trained people having initiative and inventiveness; and employment in generally favorable surroundings.

(5) Allied Trades and Industries - The service man's vocation makes for many additional opportunities for the ambitious, well-trained worker. An example is the close relationship between the radio service worker and the refrigeration service man. A combination service ability is sure to find itself in great demand.

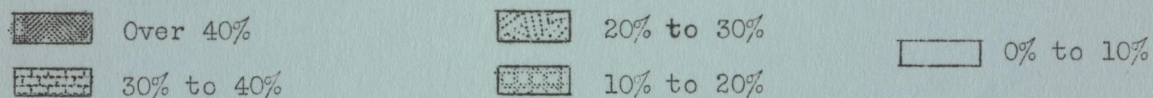
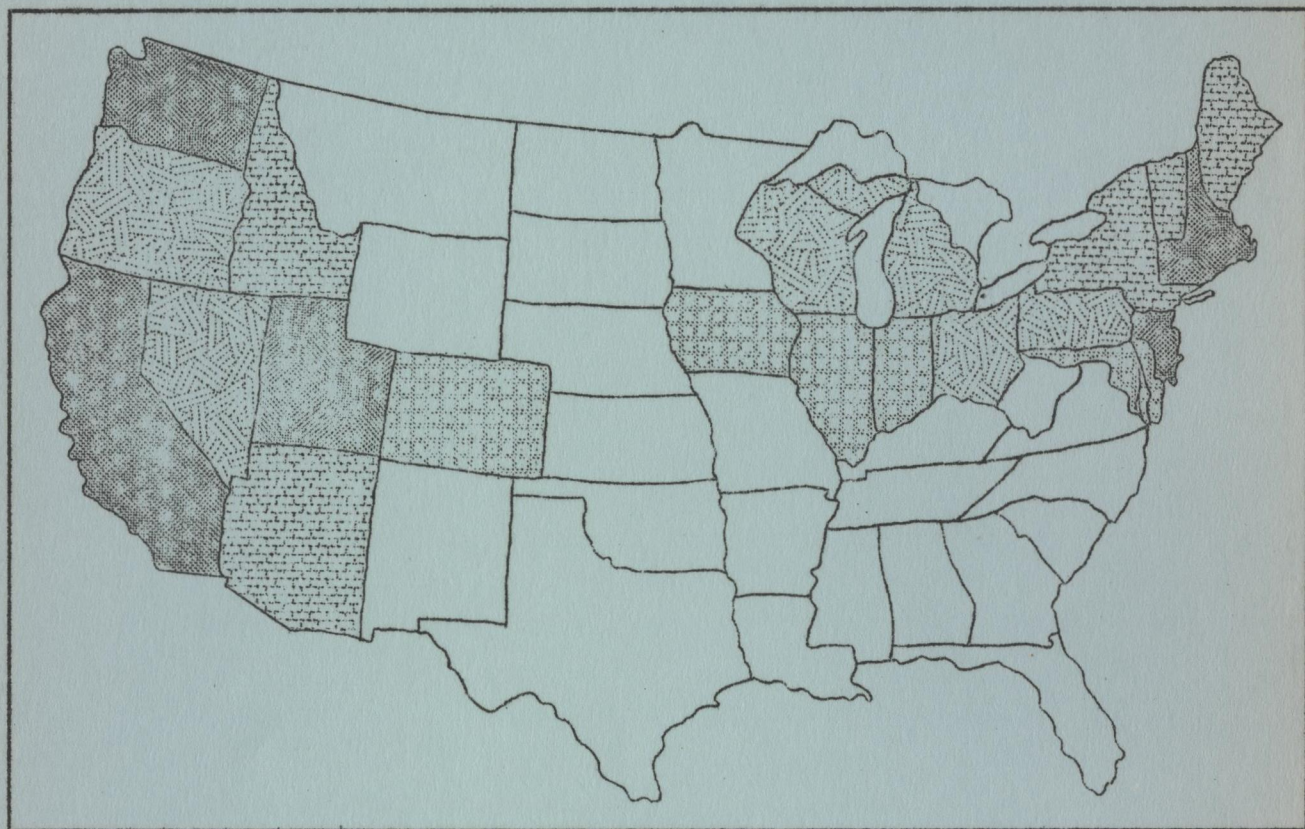
(6) A Field of Many Opportunities - The vocation of the service man offers many open doors. He has the chance to go into business for himself. He may enter government service through the Civil Service Examination. He becomes a member of a group, the demand for whose services

is growing rapidly. The program of rural electrification will open indefinite fields of employment and profit. It is a satisfaction to follow a vocation that is contributing much to make urban and rural life fuller, more attractive, and more convenient.

RURAL ELECTRIFICATION IN THE UNITED STATES

JANUARY 1, 1936

Each new electrification project means more business for the Radio
Service Man.



Average for the United States 11.6%

From "Labor Information Bulletin" - August, 1936

DISADVANTAGES OF THE RADIO SERVICE MAN'S VOCATION

The disadvantages of the radio service man's vocation are few. Some of these may be listed as follows:

(1) Irregular or long hours of work

The demand for assistance by customers sometimes compels the service man to work overtime or during an off-duty period. This is a real disadvantage, partially compensated for by extra pay.

(2) Some Unattractive Work

Not all the work of the service man is entirely desirable. Grease, dirt, soiled garments, and unpleasant surroundings occasionally may be encountered. These features are but a small part of the whole vocation, however, and may be cheerfully endured.

(3) Constant Demand for Study

The field of radio and of allied industries is rapidly expanding. To keep informed on all its advances requires constant study and reading. To many motor-minded individuals such demands would be real hardships. They cannot, however, be avoided by one ambitious to excel in this vocation. To many, such demands would impose a delightful task.

(4) Radio Service Field Overcrowded

The radio service field is overcrowded with mediocre workmen. While repairmen who do not make themselves proficient in their work may not find steady employment, experts are in demand.

SUGGESTED COURSE OF STUDY FOR RADIO SERVICING

The Vocational Division of the United States Department of the Interior has prepared a very good suggested course in Radio Servicing for the ambitious person who wishes to adopt this vocation. The course was compiled to direct the continued study of students who have had some training in the Civilian Conservation Corps or other organizations, or who have been self-taught, but are not provided with sufficient opportunities and actual practice to develop skill in radio servicing.

This outline gives a general idea of the work of the radio service man. It will help the young man to decide whether he wishes to select this occupation as a vocation. The course covers some of the more fundamental radio theories, but constant practice and continued study are necessary to keep up-to-date even after one has secured employment as a radio service man.

The following suggested course, in two parts, and the use of the Trouble-Shooting Chart, should be of great value in enabling the student systematically to follow a training for radio service man.

COURSE OF LESSONS FOR STUDY IN RADIO SERVICING

Part I

LESSON 1. RADIO SERVICE AND ITS FUTURE

The object of this study is to explain to students information about the radio field, the type of men needed, and the experience or training essential for successful employment for a prospective radio service man.

LESSON 2. DIODE VACUUM TUBES

This lesson explains to the student the operation of a simple vacuum tube and of each element and should clear up the theory of electron emission.

REFERENCES FOR STUDY: R. C. A. MANUAL R. C. 12, pgs. 1-4

LESSON 3. TRIODE VACUUM TUBES

To study the operation of a Triode Vacuum tube, the uses and limitations of these tubes, and the function of the grid.

The Cutaway tubes can be studied by getting some old tubes and carefully breaking away the glass so as to show the elements in their normal positions. Radio service men must study and know the trade terms as commonly used.

REFERENCES: TRIODE VACUUM TUBES- R. C. A. MANUAL R. C. 12

LESSON 4. TETRODE VACUUM TUBES

Study the operation of Tetrode Vacuum tubes, their advantages over Triodes, and the further need for more refined tubes to obtain greater gain.

It is advisable to know the shape of the characteristic curves of tubes.

REFERENCES FOR STUDY OF TETRODE VACUUM TUBES: R. C. A. RADIOTRON TUBE MANUAL, RADIO PHYSICS COURSE, GHIRARDI.

LESSON 5. PENTODE VACUUM TUBES

The study of Tetrode Vacuum Tubes gives the operation and use of both radio-frequency and power-type Pentode tubes.

Note the tube chart in the back of the R. C. A. Manual. It is very helpful in comparing tubes as to operating characteristics, voltages to be applied, and use in radio set.

REFERENCE: R. C. A. RADIOTRON TUBE MANUAL, RADIOTRON CO.

RADIO PHYSICS COURSE, GHIRARDI.

(These references are used throughout the course.)

LESSON 6. AUDIO AMPLIFIERS

Showing the methods of coupling vacuum tubes to each other for the purpose of getting more gain than one tube will provide. Class A., B. and A B types can be compared with reference to Class C.

It is important to remember the comparative simplicity of multi-unit tubes, and that they are just 2 or 3 small units with a common cathode.

LESSON 7. TUNED CIRCUITS AND SHIELDING

This lesson shows the need for a tuned circuit, the way it operates, and where it is used in a radio set.

All parts alluded to for demonstrating the study of Audio Amplifiers can be found in almost any radio shop. It can be studied in a radio set without dismantling it.

LESSON 8. RADIO-FREQUENCY AMPLIFIERS

The method of connecting radio-frequency amplifiers, and the advantages and disadvantages of each type are shown in this lesson. Coils from old receivers may be used to compare with the new set, showing the improvements and changes in coil design during the last ten years.

If you can get a short-wave set, it will help to impress the fact that L and C are lower in the tuned circuit of short-wave sets. A study of old parts will not only show the changes, but should the repair-man be called to service an old type radio he will be able to locate, and eliminate any trouble with more certainty.

LESSON 9. DETECTORS

The lesson gives the principles of plate-and-grid-circuit detection and shows how Diode tubes act as detectors. It is important to know correct spacing of parts so as to reduce the feedback and prevent oscillation. What the screen-grid tube does for radio-frequency amplification should be included.

LESSON 10. GRID BIAS

The need for grid bias, the methods of obtaining it, and the method of computing the size of resistor needed, are given in this lesson. (Note particularly the operation of detectors on the E_g - I_p and I_g - E_g curves, which is one of the most difficult to visualize.)

LESSON 11. RECTIFIERS AND FILTERS

To explain the action, operation and use of filter circuits (commonly known as low pass filters) smoothing out of rectified current. Explanation of bias action may be simplified with a diagram showing the bias resistors, the tubes, and the load, all as resistors. Under these conditions the circuit is a simple series which most students can easily understand.

LESSON 12. VOLUME CONTROLS AND AUTOMATIC VOLUME CONTROLS

The last of the suggested lessons in Course One for the study of Radio Servicing teaches the various methods of controlling radio set volume both manually and automatically. Remember that automatic volume-control circuits reduce the effect of fading but that no automatic volume-control system can eliminate it completely. Volume controls are being placed in the Audio System more commonly than formerly when all controls were placed in the radio-frequency end. The volume

control manual listed under "References" may usually be secured from radio manufacturers.

Unit Course Two deals with more specific repair jobs and with more advanced phases of radio servicing than were covered in Unit Course One.

If the student is to get the best advantages of the two courses, it would be well to arrange to work in a well-equipped radio shop or school where access may be had to equipment, tools and supplies.

Radio Servicing, Vocational Series #13, an outline of instruction for educational advisers and instructors or self-instructors, can be obtained for ten cents through the Superintendent of Documents, Washington, D. C.

UNIT COURSE II SPECIFIC REPAIR JOBS

LESSON 1. RADIO SERVICING PROCEDURE

Students should acquaint themselves with the qualifications of a good service man, and know the correct procedure to follow in radio service work.

LESSON 2. OSCILLATORS

This study should cover oscillators and oscillatory circuits as used in superhetrodyne radio sets, and should show how and where they are used.

LESSON 3. FIRST DETECTORS OR MIXERS

This acquaints the student with operation of first detectors or mixer tubes in which the oscillator signal and the station signal are combined to form the intermediate frequency signal. It covers the most common method of the incoming signal with the oscillator signal.

LESSON 4. INTERMEDIATE FREQUENCY AMPLIFIERS

This lesson acquaints the student with the construction, operation and use of intermediate frequency amplifiers, and shows why the gain in these amplifiers is higher than in a regular radio-frequency amplifier. An actual practice job will help to understand this study better.

LESSON 5. METERS

This study covers meters used for radio testing and methods of increasing the range of these meters. It should explain the fundamentals of meter construction and operation and explain the methods of increasing the range or adding additional ranges to ammeters and voltmeters.

LESSON 6. TUBE TESTERS AND ANALYZERS

This study should teach the operation of various meters used by radio service men to locate and remedy most types of radio trouble. It should include also such instruments used in radio service as tube testers, analyzers, volt-ohmmeters, condenser testers and oscillators.

LESSON 7. TESTING TUBES

The correct procedure in testing tubes and the correct method of interpreting results of the test are given in this lesson.

LESSON 8. TESTING RADIO SETS

This study should cover the actual testing of a set using an analyzer. Study the correct procedure of taking, tabulating, and interpreting voltage and current readings made by means of an analyzer.

REFERENCES: RADIO PHYSICS COURSE, GHIRARDI-ELECTRONEC TROUBLE SHOOTING

CHART

LESSON 9. TESTING RADIO SETS

This study should take up the point-to-point method of testing when

a volt-ohmmeter is the sole method of testing. This method is rapidly becoming popular because, as socket connections change and new tubes are placed on the market, this type of tester never becomes obsolete. Study the use, advantages, and limitations of volt-ohmmeters in radio service work.

REFERENCES: RADIO PHYSICS COURSE, GHIRARDI-ELECTRONIC TROUBLE SHOOTING CHART

LESSON 10. ALINING RADIO SETS

This study should cover the use of an oscillator and output meter for alining and neutralizing radio receivers of all types. It should show the correct procedure of methods of alining all common types of radio receivers, and should point out the most common errors made in alining.

REFERENCE: RADIO PHYSIC COURSE, GHIRARDI-ELECTRONIC TROUBLE-SHOOTING CHART

ALINING A TUNED RADIO-FREQUENCY RECEIVER

1. Place set in operation.
2. Adjust set to 1,400 kilocycles
3. Disconnect aerial and couple test oscillator to aerial and ground.
4. Connect output meter to voice coil or from the plate of the last audio tube to ground.
5. Adjust signal oscillator to 1,400 kilocycles.
6. Increase oscillator output until the output meter reads about one-third full scale.
7. Adjust trimmers for maximum output meter reading. This usually requires more than one adjustment to each trimmer.

8. When the volume continues on up, and the trimmers is either all in or out, it is then necessary to adjust all trimmers to about one-half capacity and repeat Steps 6 and 7.
9. Set radio to 600 kilocycles.
10. Adjust oscillator to 600 kilocycles.
11. Aline for maximum output by bending the rotor plates.

ALINING A SUPERHETRODYNE RECEIVER

1. The tuned radio-frequency stage, oscillator, and first detector trimmers are usually located on the gang condenser, and the alinement procedure Steps 1 to 8 can be followed.
2. To adjust the 600 kilocycles, adjustments 9 and 10 are followed, but a special 600 kilocycle trimmer is provided for the adjustment, and the tuning condensers should be rocked back and forth while making this adjustment.
3. When adjusting the intermediate-frequency amplifiers, the oscillator signal of the correct i. f. frequency should be applied to the grid of the first detector. (The cap is first removed.)
4. Alinement of the intermediate-frequency amplifiers, usually located inside the shield, is for maximum output on the output meter.
5. If the intermediate-frequency requires much adjustment, it is advisable to repeat all steps in the alinement of the set.

REFERENCE: RADIO PHYSICS COURSE, GHIRARDI-CHART OF ALINING RADIO RECEIVERS

LESSON 11. CAR RADIO SETS

This study will cover the operation and installation of car radio receivers, how they differ from house sets, and the operation of "B"

eliminators in common use in both modern and older sets.

LESSON 12. CAR RADIO SETS (Continued)

The elimination of noise from car radio installation due to common causes is the subject of this lesson. Knowing how to diagnose, locate, and eliminate the various types of interference commonly encountered in car radio work is of primary importance to the service man.

SPECIFIC REPAIR JOBS

Radio-Servicing Procedure

- I. Examine set and tubes.
- II. Test all tubes.
- III. Classify type of trouble as —
 1. Equipment inoperative.
 2. Low volume.
 3. Distortion.
 4. Oscillation (whistling).
 5. Noisy.
 6. Fading.
 7. Intermittent operation.
 8. Hum.
 9. Overheating.
 10. Poor selectivity.
 11. Poor control of volume.
- IV. After the type of trouble is known the attached chart may be used to locate it.

Use of Trouble-Shooting Chart

- I. Locate the difficulty encountered under the page heading "Trouble".
- II. Under this heading in column marked "Symptoms" are listed the visible or audible indications of this trouble which must be observed or for which tests must be made.
- III. In the column headed "Cause" are listed the possible causes of the trouble and in the column headed "Remedy," the method of repair.

RADIO TROUBLE-SHOOTING CHART

Trouble: Equipment Inoperative

Symptom	Cause	Remedy
1. One or more tubes do not light.	1. Burned-out-filament.	1. Replace.
	2. Shorted socket.	2. Clear Short.
	3. Shorted supply.	3. Replace.
	4. Shorted pilot lamp or leads	4. Install new leads.
	5. Open filament circuit.	5. Install new leads.
	6. Poor socket connections.	6. Bend spring.
	7. Open supply.	7. Repair or replace.
2. All tubes do not light	- - - -	- - - -
	1. See symptom 1.	1.
	2. Fuse blown.	2. Replace.
	3. No voltage at source.	3. Check supply.
	4. Ballast tube or resistor open.	4. Replace
	5. Open supply.	5. Repair or replace
	6. Broken switch.	6. Replace
	7. Burned out tube in a series filament hook-up.	7. Replace bad tube.
	8. Poor attachment, plug, cap, outlet, or cord.	8. Repair.
3. No or low voltage-	9. Open rheostat in filament lead.	9. Repair or replace.
	- - - -	- - - -
	1. High plate current due to no bias.	1. Replace bias resistor or cathod bypass condenser.
	2. Shorted filter condenser.	2. Replace.
	3. Open lead.	3. Replace.
	4. Poor rectifier tube.	4. Replace.
	5. Poor battery.	5. Replace.
	6. Shorted plate bypass condenser.	6. Replace.
	7. Open choke filter.	7. Replace.
	8. Open coupling device.	8. Replace.
	9. Grounded choke in filter.	9. Replace.
	10. Open voltage divider.	10. Replace or mend with new section.
	11. Open condenser in filter	11. Replace.
	12. Vibrator unit not working	12. Adjust or replace unit.
	13. Vibrator condenser open or shorted.	13. Replace.
	14. Open high voltage secondary.	14. Replace.
	15. High grid voltage.	15. Replace bias resistor.

RADIO TROUBLE-SHOOTING CHART (cont.)

Trouble: Equipment Inoperative (cont.)

Symptom	Cause	Remedy
3. (cont.) No or low voltage-	16. Open rectifier tube, filament, or supply	16. Replace.
	17. Open cathode bias resistor	17. Replace.
	18. Open cathode bias resistor as volume control.	18. Replace.
	19. Shorted tube--cathode to plate.	19. Replace.
	20. Open speaker field.	20. Replace or repair.
4. No or low grid voltage-----	1. Open screen resistor.	1. Replace.
	2. Shorted screen bypass.	2. Replace.
	3. No plate voltage. (See symptom 3.)	3.
	4. Open volume control if in screen grid circuit.	4. Replace.
	5. Grounded volume control in screen grid circuit.	5. Insulate, shaft or lead.
5. No or low grid voltage-----	1. Shorted grid bias bypass condenser.	1. Replace.
	2. Open grid bias resistor.	2. Replace.
	3. Open grid circuit.	3. Repair or replace the coupling unit.
	4. Poor tube.	4. Replace.
	5. See symptom 3 or symptom 6.	5.
6. No or low current-	6. Grounded volume control in cathode circuit.	6. Insulate control.
	1. See symptom 3.	1.
	2. Poor tube.	2. Replace.
	3. See symptom 7	3.
	4. See symptom 4	4.
7. High control grid voltage-----	5. Automatic volume control resistors bad.	5. Replace.
	1. See symptom 8.	1.
	2. If of opposite polarity shorted blocking condenser.	2. Replace.
	3. High bias resistor.	3. Replace with correct size.
	4. Automatic volume control tube.	4. Replace.

RADIO TROUBLE-SHOOTING CHART (cont.)

Trouble: Equipment Inoperative (cont.)

Symptom	Cause	Remedy
8. High plate current	1. Gassy tube.	1. Replace.
	2. See symptom 5.	2.
	3. Shorted coupling condenser	3. Replace.
	4. See symptom 15.	4.
	5. Shorted out-put coupling device.	5. Replace.
	6. High screen voltage.	6.
	7. Cathode to heater short.	7. Replace tube.
	8. Cathode to plate short.	8. Replace tube.
	- - - -	- - - -
	1. Open voice coil (shorted).	1. Repair or replace cone assembly
	2. Open coupling condenser.	2. Replace.
	3. Shorted coupling device.	3. Replace.
	4. Out of alinement.	4. Aline with an oscillator and output meter.
	5. Shorted variable condenser.	5. Adjust.
	6. Shorted tuning condenser.	6. Insulate.
	7. Shorted speaker field.	7. and 8 Depends upon position of trouble whether a repair or replacement is necessary.
	8. Open speaker field.	9. Replace
	9. Poor oscillator tube.	10. Replace.
	10. Grounded aerial (or lightning arrestor).	11. Replace.
	11. Grounded radio-frequency transformer	12. Repair or replace.
	12. Shorted intermediate-frequency transformer.	13. Repair or replace.
	13. Shorted intermediate-frequency transformer.	14. Replace.
9. All readings O. K.	14. Poor photo cell, pickup microphone, etc.	15. Adjust with milli-ampere in series.
	15. Relays out of adjustment. on photo-cell amplifier.	16. Adjust with milli-ampere in series.
	16. Sensitivity adjustment or photo-cell amplifier not adjusted.	17. Clear Ground.
	17. Grounded grid.	18. Repair and use short leads.
	18. Too much leakage due to photo-cell socket or leads.	

RADIO TROUBLE-SHOOTING CHART (cont.)

Trouble: Equipment Inoperative (cont.)

Symptom	Cause	Remedy
9. All readings O.K. (cont.)	19. Shorted tone control in grid circuit or plate circuit.	19. Repair or replace.
	20. Open primary if fed capacitively from plate. Plate voltage supplied through resistor.	20. Repair
	- - - -	- - - -

Trouble: Low Volume or Poor Operation

Symptom	Cause	Remedy
10. No or low grid and plate readings.	1. See symptom 3, 5, and 6.	1.
	- - - -	- - - -
	1. Too short an aerial.	1. Put up a good outside aerial.
	2. Grounded aerial or lead-in, including lightning arrester.	2. 50 to 75 feet in length.
	3. Shorted or open speaker field or field supply.	3. Repair or replace
	4. Rectifier in speaker field circuit in poor condition.	4. Replace
11. Readings all O.K.	5. Poor automatic volume control action.	5. Check all resistors and try a new tube.
	6. Open or low capacity coupling condenser.	6. Replace.
	7. Open bypass condenser (plate cathode screen).	7. Replace.
	8. One or more shield out of place.	8. Replace.
	9. Out of alinement.	9. See chart on alining.
	10. Shorted volume control if in the aerial circuit.	10. Replace.
	11. Poor photo cell, mike or pick-up.	11. Repair or replace.
	- - - -	- - - -

RADIO TROUBLE-SHOOTING CHART (cont.)

Trouble; Distortion, Chattering

Symptom		
12. No or low plate or grid readings.	1. See symptom 3, 5, and 6	1.
	-----	-----
	1. Shorted filter choke.	1. Replace.
	2. Shorted speaker field.	2. Replace.
	3. Shorted coupler device.	3. Replace.
	4. Open voltage divider.	4. Replace.
13. High plate voltage.	5. Not all load connected.	5. Reconnect.
	6. Bleeder open.	6. Replace.
	7. High line voltage.	7. Call power company.
	8. Shorted ballast tube.	8. Replace.
	9. Open or loose wire.	9. Replace.
	10. Wrong position of the tap switch.	10. Throw the other way.
	-----	-----
	1. Speaker cone not centered.	1. Adjust.
	2. Speaker cone not free	2. Adjust and make it free.
	3. Speaker cone injured or spider hardened.	3. Replace.
14. All readings O.K.	4. Shield out of place.	4. Replace.
	5. Push-pull tubes not balanced.	5. Replace both.
	6. Shorted section of the push-pull transformer.	6. Replace.
	7. Poor tube that does not show up on tester.	7. Replace.

RADIO TROUBLE-SHOOTING CHART (cont.)

Trouble: Oscillation, Whistling or Blocking Out at High Volume

Symptom	Cause	Remedy
15. High plate voltage	1. See symptom 13. - - - -	1. - - - -
16. Low grid voltage--	1. See symptom 5. - - - -	1. - - - -
17. High filament voltage-----	1. High-line voltage. 2. Set on wrong primary tap. 3. Partially shorted primary. - - - - 1. Shield loose or off. 2. Out of alinement. 3. Poor tube. 4. Open bypass. a. Cathode. b. Plate. c. Screen.	1. See power company. 2. Switch over. 3. Replace transformer. - - - - 1. Replace. 2. Aline. 3. Replace 4. Replace
18. All readings O.K.--	5. Poor ground ground on condenser can (forks dirty). 6. Shorted grid suppression. 7. New tubes. 8. Not neutralized. 9. Grid leads too close together. 10. Open grid return. 11. Capacity turn on wire giving too much feed back. - - - -	5. Clean with sandpaper. 6. Replace. 7. Use 1 poorer tube if no other method works. 8. Neutralize set. 9. Space farther apart. 10. Connect and solder. 11. Move away so that less coupling exists. - - - -

RADIO TROUBLE-SHOOTING CHART (cont.)

Trouble: Equipment Noisy.

Symptom	Cause	Remedy
19. Jumpy voltage readings.	1. See symptoms 3,4,5,7,13, 15,16, and 17, showing causes for voltage to be low or high as these causes will also cause voltage to fluctuate if the trouble is intermittent.	1.
	-----	-----
	1. Loose shields or connections.	1. Tighten.
	2. Dirty variable condenser	2. Blow out or clean with pipe cleaners.
	3. Poor tubes	3. Replace.
	4. Dirty or loose line control	4. Clean with carbon tetrachloride or replace.
	5. Poor coupling devices.	5. Replace or drying may cure.
	6. Poor resistor.	6. Replace.
	7. Poor condenser.	7. Replace.
	8. Static.	8. No remedy.
	9. Man-made interference	9. Locate and try to eliminate.
	20. All readings O.K.	10. Move away or use a shielded lead-in.
	10. Aerial close to powerline.	11. Repair.
	11. Poor connections in speaker (on voice coil).	12.
	12. In car radio motor noises see special chart.	13. Clean.
	13. Poor contact on phonograph switch	14.
	14. Poor local-distance switch	15. Replace
	15. Leaky filter condenser.	16. Bond around meter.
	16. Poor ground through water meter.	-----
	-----	-----

RADIO TROUBLE-SHOOTING CHART (cont.)

Trouble: Fading (Smooth Dying Out Of The Signal Which
May Or May Not Return to Normal Volume)

Symptom	Cause	Remedy
21. Plate grid or filament readings are changing	1. See symptom 12.	1.
	One or all tubes do not light.	
	No or low screen grid voltage.	
	No or low plate current.	
	High control grid voltage.	
	High plate current.	
	High plate voltage.	
	High filament voltage.	
	- - - -	- - - -
	1. Atmospheric condition.	1. No remedy.
22. All readings O.K.	2. Open coupling condenser.	2. Replace.
	a. Open plate bypass condenser.	
	b. Open cathode bypass condenser.	
	c. Open screen bypass condenser.	
	3. Oscillator tube drifting.	3. Replace tube
	4. Poor automatic volume control tube.	4. Replace.
	Poor automatic volume control resister.	
	- - - -	- - - -

RADIO TROUBLE-SHOOTING CHART (cont.)

Trouble: Intermittent Operation (Choppy)

Symptom	Cause	Remedy
23. Plate, grid filament jumpy.	1. See symptom 3,5,6,4,1,7,8,13,17. - - - - 1. Poor socket contact. 2. Shorting or open voice coil 3. Shorting or open field on speaker. 4. Poor tube. 5. Aerial or ground connection shorting of opening 6. Poor connection. 7. Poor coupling device. 8. Poor cathode bypass condenser. Poor plate bypass condenser. Poor screen bypass condenser. 9. Poor tone control.	- - - - 1. Clean and reset contacts. 2. Repair or replace. 3. Repair or replace. 4. Replace 5. Repair 6. Repair 7. Repair or replace. 8. Replace. 9. Replace
24. Readings all O.K.	1. See chart subhead "Fading". - - - -	- - - - 1.
25. Might be fading--		

Trouble: Hum		
	1. Open filter condenser. 2. Open center tap resistor. 3. Open bias bypass. 4. Shorted filter choke. 5. Cathode to heater short. 6. Filament to grid short. 7. Poor rectifier tube. 8. Sensitive leads not properly routed. 9. Out of balance push-pull tubes. 10. Loose field coil in speaker or transformer. 11. Shorted field bypass. 12. Set out of alinement (oscillation). 13. Loose lamination. 14. No or poor ground.	1. Replace. 2. Replace. 3. Replace. 4. Replace. 5. Replace tube. 6. Replace tube. 7. Replace tube. 8. Shield or reroute. 9. Replace. 10. Seal with wax. 11. Replace. 12. Aline. 13. Clamp them tight. 14. Make good ground connection to cold-water pipe.

RADIO TROUBLE-SHOOTING CHART (cont.)

Trouble: Overheating

Symptom	Cause	Remedy
27. Incorrect readings	1. See symptoms 3,5,6,4,1,7, 8,15,17. - - - -	1. - - - -
28. Readings all O. K.	1. Moisture in transformer. 2. Resistor of too low wattage 3. Partially shorted trans- former. 4. Operated too close to a radiator. - - - -	1. Dry out or replace. 2. Replace with same resistance but higher wattage resistor. 3. Replace. 4. Locate set in dif- ferent spot. - - - -

Trouble: Poor Selectivity

29. All readings O.K.	1. Too long an aerial. 2. Out of alinement. 3. Poor shielding. 4. Set may not be any better - - - -	1. Shorten. 2. Aline. 3. Replace shields or install new ones. 4. - - - -
30. Incorrect readings	1. See symptoms 3,5,6,4,1,7, 8,15,17. 1. Poor tubes 2. Out of alinement 3. Too short an aerial. 4. Poor ground connection. 5. Defective volume control. 6. Not neutralized. 7. Moisture in set. 8. Shield on coils not in place. 9. Open aerial coil 10. Open cathode 11. Open condenser. 12. Open plate. 13. Open screen 14. Poor automatic volume condenser action. 15. Shorted coupler or tun- ing unit. - - - -	1. Replace. 2. Aline. 3. Install one 50ft to 75 ft. 4. Make good connection to cold water pipe. 5. Replace. 6. Neutralize. 7. Bake out. 8. Replace. 9. Rewind or replace. 10. Replace. 11. Replace. 12. Replace 13. Replace. 14. Replace resistors or tube. 15. Replace. - - - -

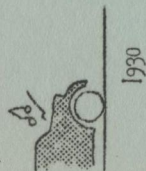
RADIO TROUBLE-SHOOTING CHART (cont.)

Trouble: Poor Control Of Volume

Symptom	Cause	Remedy
32. Incorrect readings	1. See symptoms 3,5,6,4,1,7, 8, 15, 17. - - - - -	- - - - -
	1. Poor control rheostat.	1. Replace.
	2. Grounded control rheo- stat.	2. Replace or reinsu- late.
	3. Poor automatic volume control action.	3. Replace tube or resistor.
33. Readings all O.K.	4. Poor tubes.	4. Replace.
	5. Poor shield contact	5. Clean contact area.
	6. Shorted cathode bypass condenser.	6. Replace.
	7. 1 section of a dual rheostat. - - - - -	7. Replace. - - - - -

COMPARISON OF NUMBER OF CARS EQUIPPED WITH RADIO

1930 - 1935



1935

112536-66

Legend-  = 200,000 automobiles

CAR RADIO INTERFERENCE

LOCATING INTERFERENCE IN CAR RADIOS

1. Disconnect aerial.
2. If interference stops, it is coming in on aerial. (Be sure hood is down)
3. If interference does not stop, ~~it~~ is coming in on battery leads, or through openings in the case.
4. Check by sound to determine part causing interference.
 - a. Clicking-ignition.
 - b. Hum or whirring buzz - generator or electric motor.
 - c. Intermittent cracking - loose connections.
 - d. Accumulative discharge.

CAN YOU ANSWER THE FOLLOWING?

1. What is the nature of the sound caused by a generator?
2. What is a dome-light filter?
3. How can a dome-light filter be constructed?
4. What is the resistance of a spark-plug suppressor?
5. How is noise, created by friction on the road, eliminated?

METHOD OF ELIMINATING OR PREVENTING INTERFERENCE

1. Always use shielded wire and ground the shield.
2. For aerial lead, shield should be large.
3. Use suppressor (about 25,000 ohms) in each plug lead and in distributor lead. (Place close to plug and distributor.) Adjust plug and break points.
4. Place condenser from--
 - a. Coil to ground.
 - b. Hot side of generator to ground.
 - c. Hot side of ammeter to ground.
 - d. Hot side of gas gauge to ground.
 - e. Hot side of dome light to ground.
 - f. Hot side of stop light switch to ground.
 - g. Any hot wire to ground.
5. Put switch in hot dome light wire at post or on dash.
6. Keep as far away as possible from the coil and high-tension leads.
Move primary leads away from high-tension leads.
7. Keep aerial away from dome light and all metal.
8. Use a roof aerial.
9. Connect the battery leads of set directly to the battery.
10. Place a screen under the front floor mat and ground same.
11. Bond any part on car that is causing interference, especially all parts passing through fire wall.
12. Check for poor connection by taking voltage drops from--
 - a. Hot side of battery to distributor case.
 - b. Hot side of battery to ground.

- c. Ground side of battery to distributor case.
13. Solder on rotor of distributor to make it a wipe contact (not best practice).
 14. Shield high-tension wire (not best practice). Shield bakelite end of coil with a metal can. Clean high-tension contacts.
 15. Ground hood.
 16. Put chokes (radio frequency) in light wires (especially dome light), also condenser to ground.
 17. Try another battery you know to be good.
 18. Ground set frame or box (if not already grounded).
 19. Ground B eliminator box (if not already grounded).
 20. Repair loose or swinging wires on car wiring if trouble appears to be due to poor connections or bad wiring.
 21. Place a 0.002 or 0.006 mica condenser across the breaker points.
 22. Shorten distributor condenser lead. Ground front wheels with a conical spring in dust cap.
 23. Readjust brakes.
 24. Bond brake rods.
 25. Clean and refit set cover and parts.
 26. Cover and shield cable plugs.
 27. Insert a radio-frequency choke in "hot" A battery lead. Construct radio-frequency choke with 20 turns of No. 12 or No. 14 wire on a wood spool and place a 0.5 millifarad condenser from the radio set or battery side of the choke to ground.
 28. Drive small tacks in door hinges to ground door panels to body.
 29. Shield starter.

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- The Radio Beginner, by J. M. Borst.
- Radio Physics Course, by Alfred A. Ghirardi.
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